PAPERS

IN

CHEMISTRY.

The GOLD ISIS MEDAL *was this Session voted to Mr.* GEORGE FIELD, *of Heath Cottage, Hounslow, for his Apparatus for preparing Coloured Lakes. The following Communications were received from him, and several Specimens of the Lake are preserved in the Society's Repository.*

SIR,

I HAVE the honour to lay before the Society of Arts. &c. the plan of a very simple and efficacious machine, called a *Physeter*, or *Percolator*, for filtrating liquids with great expedition. Its powers are too evident upon the face of the enclosed plan and description, to require certifying; and the machine itself may be *seen in use.

I have the honour to be, Sir,
Your obedient humble Servant,

G. FIELD.

Heath Cottage, Reading Road, Hounslow,
Nov. 1, 1814.

To C. TAYLOR, M. D. SEC.

* The Committee of *Chemistry* went to Mr. Field's, Heath Cottage, Hounslow, and inspected the Machine, while in use.

SIR,

IN compliance with the desire of those gentlemen of the Society of Arts, &c. who did me the honour to inspect my apparatus, that I should extend my late communication, I beg to submit to the Society, first, the following more particular description of my *Physcter*, or *Percolator*.

Fig. 1, is a vertical section of the machine.—*a* A strong tub.—*b* A hoop fixed therein.—*c* A sieve of copper wire, inverted horizontally on the hoop *b*.—*d* A small lifting pump. The strainer *c* is covered in the first place with woollen baize, and secondly with silken cloth of the kind called lutestring, thin edges being passed over the rim of the strainer; the space between which and the tub is securely packed air-tight with a list of woollen cloth, the whole is then secured by the hoop *f*, the ends of which *f f*, touch each other within the tub, and the hoop, by driving, fits so closely to the sides of the tub, and on the rim of the strained *c*, as to render the whole air-tight, and secures the packing in its place; and, it is farther secured by copper nails driven through it.

Fig. 2, is a section of part of the strainer, on a larger scale, which shows how the strainer, baize, and silk, is packed.

Fig. 3, is an elevation of the whole machine, showing the pump *d*; two cocks *g* and *h*; and a funnel *g*, by which the bottom part may be filled with water, the air escaping at the cock *k* which saves time, as the first stroke of the pump lays the whole weight of the atmosphere on the filters; the cock *h* also serves to regulate or diminish the force of the exhaustion by letting air in again below.

Fig. 4, a tripod or moveable stand, constructed with two hoops, and three legs, about sixteen inches diameter, and two feet three inches high:—*i*, A filter made of a conical bag, placed within

within a hoop, over which the edge of it is returned, and secured by another hoop fitted tight over the first as shewn at fig. 5. *k* A lid to keep the materials clean. This filter rests loose on the tripod, and may be easily changed; another filter may also rest on the lower hoop *l*, to farther purify the liquid when needful.

Fig. 6, shows a simple method of supporting them against a wall, by two rails *l m*, the rail *m* being placed the thickness of the hoop (two or three inches) lower, and forwarder than the other.

Fig. 7, is a screw-hoop for filters of very large dimensions, in which a conical bag of net-work or strong canvas is fixed, to support the filtering medium.

Fig. 8, a thick board, with fluted conical holes in it, to support a number of small filters of cloth, silk, or paper, placed over a bason, as at fig. 9.

Figs. 10 and 11, exhibit the means by which conical bags are formed of a double square of silk or cloth, *n o p q*, fig. 10, folded at *n o*, and the edges sewed in a flat seam from *q* to *p*: and thus half a yard of yard-wide cloth, forms this filter; when the filtering angle at *o*, fig. 11, is worn out, a second may be formed at *n*; first unripping the former seam by the same means, and so on at the other two angles; thus making it both durable and economical, it lasting four times as long as is usually the case with filters.

Fig. 12, is a small filter, formed of a square silk, or cloth, merely by twice folding it across.

Such is the plan of this machine in its most simple form: —It is, however, capable of numerous variations, among which are principally worthy of notice—First, That it may be reversed. Let the under space be *open* to the atmosphere, and the top of the tub *closed* air-tight, except a small opening

to

to communicate with an apparatus for *injecting* the percolating liquid, or air, to press upon it; and secondly, the plan, by *exhausting* the under space, may be combined with the present, of injecting the space above; of course, with double power. The purpose, however, for which I filter, will determine the best mode of applying my principle; if such purpose be the purification of liquids, the mode of injection may, in some cases, be the most appropriate; and when precipitates, or the matter to be separated from liquids, is the purpose of filtration, the mode of exhaustion may be the best: in the first case by a *forcing*, and in the latter by a *lifting pump*.

Pure water is so essential an article of life, that a filtering machine is almost indispensable on board of every ship, and in most chemical arts it is highly necessary. The present plan is both portable and compact, equally adapted to sea-service as to domestic use. When applied to the purification of water, it may be used simply as a pump, since the withdrawing of pure water for use, prepares the machine for a new supply, in resemblance of the well or fountain; at the same time that no dirt, or extraneous matter, can possibly get into the purified water. In this latter use, the addition of some sheets of filtering paper, or other proper medium, between the cloths of the strainer will be requisite; but in separating or collecting precipitates (for which this machine was constructed), this addition is unnecessary.

The next article I am desirous of submitting to the investigation of the Society, is an *Air Stove*, being a simplification of the drying stove, formerly honoured by the reward of the Society.

The draft of this stove is so good as to reduce small pit-coal and ashes to a slag, yet the interposition of air between the

the fire and chambers of the stove, so moderates and regulates its action, as never to produce a *scorching* heat therein.

The principle of this stove is applicable also to the heating and circulating of air within a room, for the purposes of health and comfort, as well as drying, either by a *close* or *open* fire-place; and I have succeeded in rendering two remarkably cold rooms exceedingly warm and comfortable by its use.

The heat, and rarefaction of the air, by the iron arch over the fire, causes it to pass in a free current through the ventilator into the room, communicating *salutary warmth without closeness.* The smoke of the fuel passes back under the crown of the fire-place, and rises behind it into the chimney.

I have now to submit to the judgment of the Society, the following plan of a compound press, contrived for the double purpose of pressing by weight and power.

Pressure is a mechanical subject of no mean extent and application, both nature and art producing many important purposes by its means. These means are either active, passive, or compound. Active is the application of the mechanical powers, passive by weight and compound when both these are united.

The principal and superior advantages of *pressure* by *weight*, are that it is equable, and continuing without attendance. Its disadvantages—That its force is comparatively small, and that the power required to manage it is equal to that which it exerts in pressing, while its comparative bulk is excessive. The principal and superior advantage and disadvantage of *pressure* by *power* are exactly the reverse of those by weight; strong but not continuing—easily manageable, but requiring attendance, and of little comparative bulk.

The

The design in the present plan is to unite these advantages, and correct their disadvantages by opposing them.

I have the honour to be, with great respect, Sir,
your most obliged humble Servant,
GEORGE FIELD.

Heath Cottage, Reading Road, Houns low, March 20, 1815.

To C. TAYLOR, M. D. SEC.

Reference to the Engraving of Mr. George Field's Drying Stove and Press.

Fig. 1, is a perspective view of part of the drying stove, showing a vertical section through the flue, between the hot closets, and one of the closets open; and having the three bottom stages separated, to show their construction better.

a The ash-pit in the first or bottom stage, supplying air to the fire *a*, in the second stage; the flue of which pursues the course of the arrows *a a a*, &c. over the air course of the first stage, and under the air course of the third stage, thus making the air very hot, then rising through the third stage at the back corners *a a*, and above the iron floor *c c* of the two closets; the right and left currents unite in one flat or thin flue, extending from back to front between the two closets, (as shown in the section) the partial partition *d*, being put to make the smoke travel to the front, and then back again to ascend the chimney *e*: each course being separated from that above it by cast-iron plates, with apertures in them where necessary. *b b*, The two air courses in the bottom stage, which unite and ascend through the second stage at the back of the fire into the third stage, where they divide again

again right and left, travelling all over the fire flue by the courses shown by the arrows *b*, *b*, *b*, &c. and joining over the fire, they divide; the air being then very hot at *f*, enters into the right and left closets *g*, *g*, fig. 4, where, travelling in a zig zag course between the iron or copper tinned trays in each, they join again in *h*, and the air finally escapes into the flue by the register *i*: the arrows *a*, *a*, &c. showing the fire flue; and the arrows *b*, the air-course all the way to the register *i*.

Fig. 2, is a section of the left chamber, showing the current of hot air between the trays, entering at the bottom *b*, and escaping as shewn by the arrow *b* at top.

Fig. 3, shows how the trays are placed alternately over each other, and are each supported on two iron bars *k*, *k*, &c. let into each course of brick-work.

Fig. 4, a perspective view of the whole stove in action; *a* the ash-pit; *b*, *b*, the air-courses, and the register *i* open; the chamber doors *g*, *g*, shut; *h*, *h*, the top of the flues.

Fig. 5, a compound press for extracting tinctures, &c.; *b* the screw represented in section 1; *m*, a hard metal socket, on which the nose of the screw acts when pressed down with oil in it, fixed fast on the play-board: *n*, *n*, the sides of a cast-iron rim or box to contain two or four square cast-iron weights, to load the press with occasionally; *o*, a bridge or staple, through which the cylindrical end of the screw passes, and is kept from rising out of it by a collar fixed on its nose, by means of a pin passing through it. This bridge allows the loaded play-board to descend without the screw, thus keeping a continual pressure on the substance contained in a bag *q*, &c. to be operated upon, which can be increased or diminished at pleasure, by putting more or less weights into the box; and finally, the power of the screw can be exercised to get out

out the remaining dregs, as well as to raise the box up again.

Fig. 6, an end view of the press; *p. p*, two of four rollers to guide the play-board of the press.

The GOLD MEDAL *and* ONE HUNDRED GUINEAS *were this Session presented to Mr.* JAMES RYAN, *of Netherton Colliery, near Dudley, for his Method of Ventilating Coal Mines. The following Communication was received from him, explanatory Engravings are annexed, and a Model is preserved in the Society's Repository.*

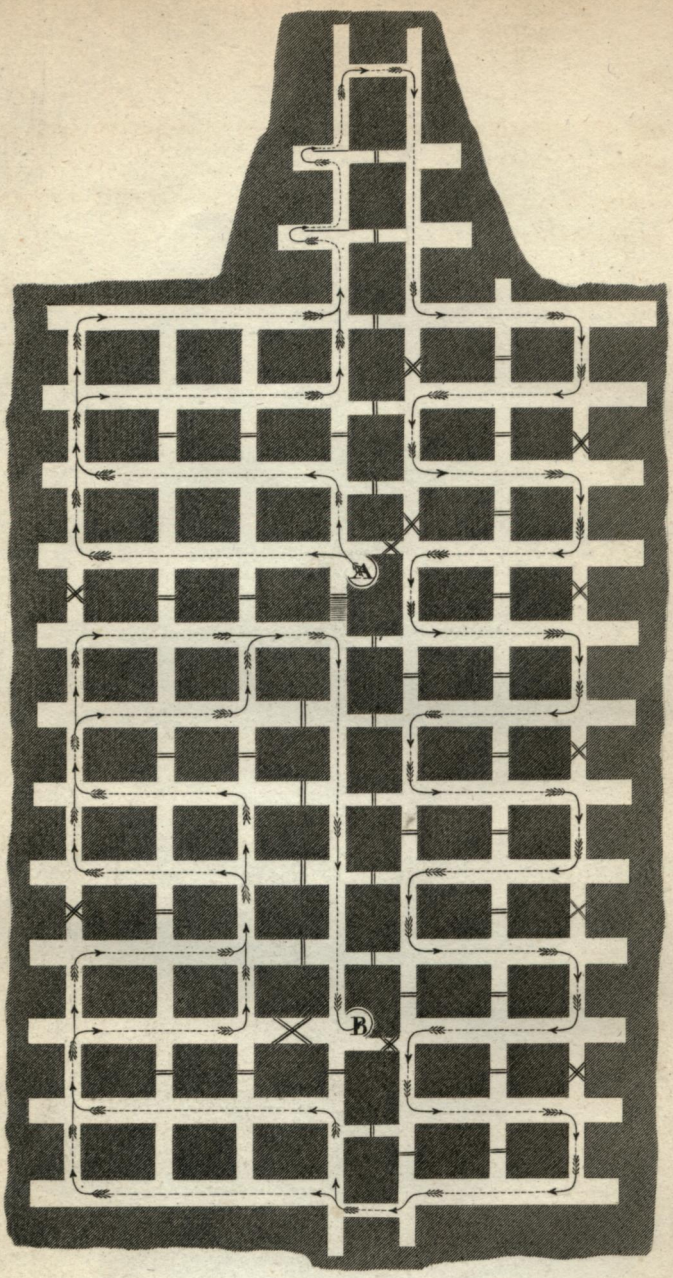
SIR,

THE numerous and melancholy accidents which have happened in the coal mines of Great Britain for a long period, and particularly within the last few years, have attracted the attention of the humane and scientific part of the community to the subject of discovering a better system of ventilation than that hitherto adopted.

Accustomed as I was by my profession to these distressing scenes, humanity soon prompted me to exercise whatever ability, practice and experience had given me in devising a method to prevent the repetition of accidents so baneful in their effects.

Having brought my plans to a degree of practical perfection, I beg leave to lay before the Society for its approbation, an entire new system of ventilating coal mines, founded upon the results of thirteen years intense application, and nine years actual and severe experience.

Previously

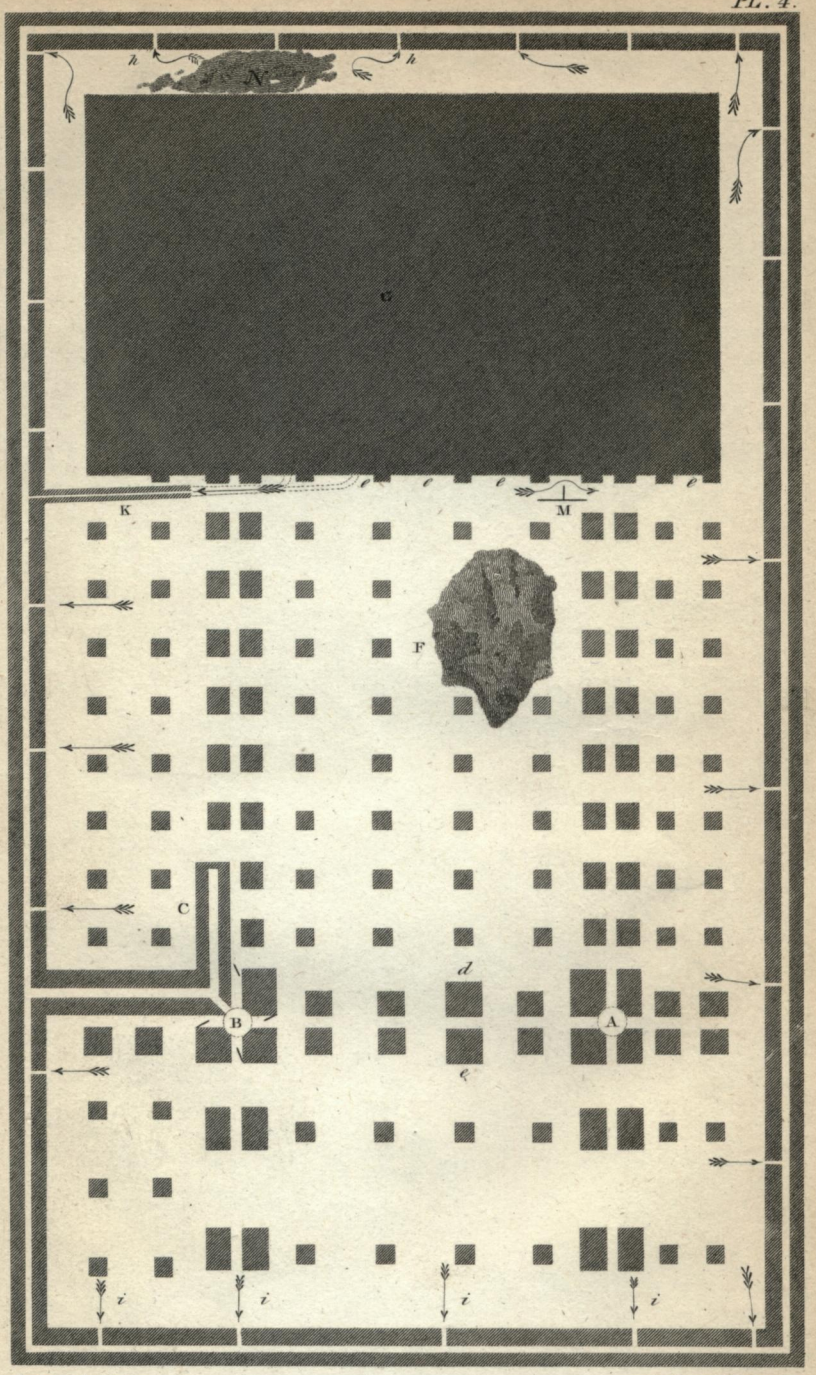


Drawn by C Varley

Engraved by A W Warren.

A Ground Plan of the General System of Working and Ventilating Coal Mines.

PL. 4.



Drawn by C. Varley.

Engraved by A.W. Warren.

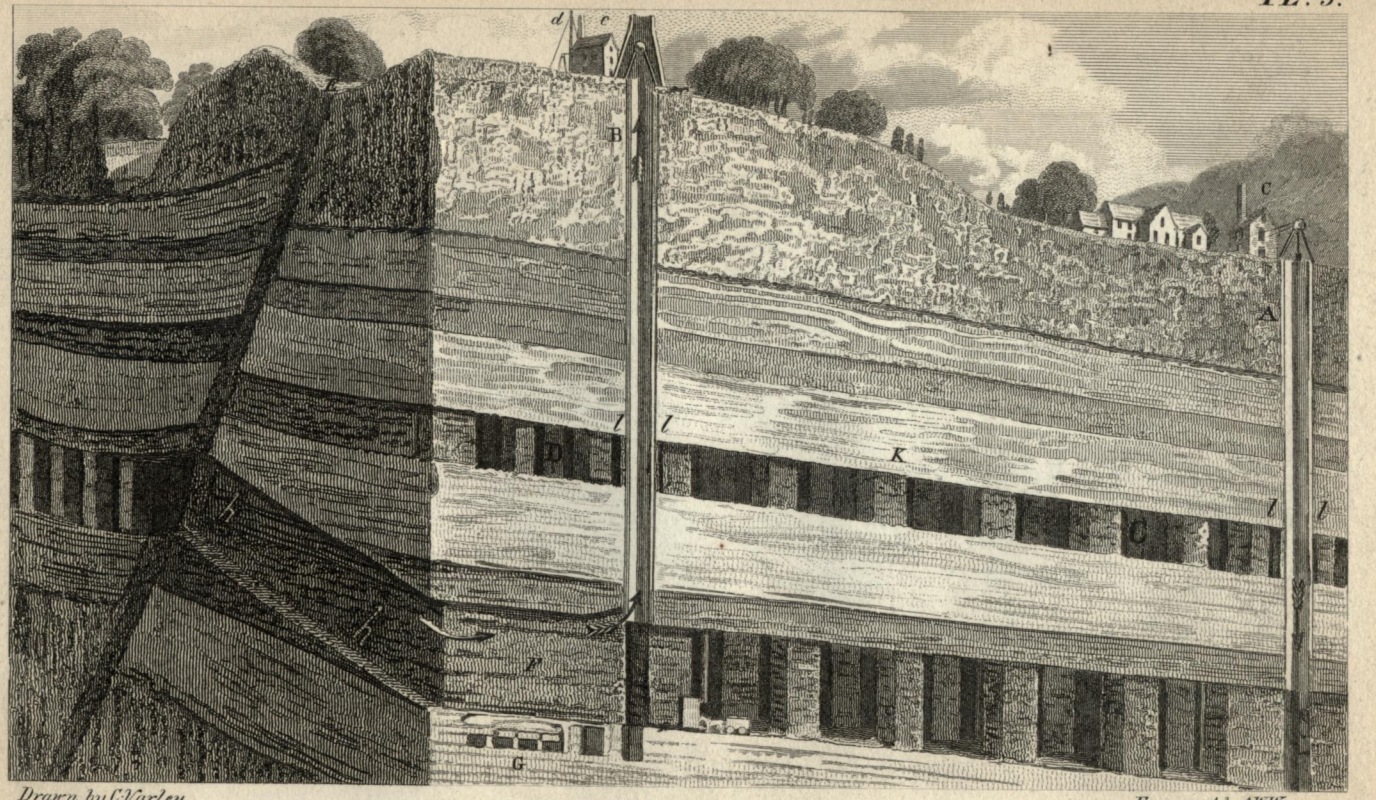
A Ground Plan of Mr. James Ryans System of working and Ventilating Coal Mines

Drawn by C Varley

Engraved by A W Warren

Sections of the Coal Mine

PL. 5.



Drawn by C Varley.

Engraved by A W Warren.

Sections of the Coal Mine at right Angles.

Previously to laying before the Society the detail of my system of ventilation, it will be necessary to describe the method adopted hitherto.

The annexed plate, No. I., of the ground plan of a Colliery, is taken from the first report of the Society for preventing accidents in coal mines; printed by Edward Walker, Newcastle, 1814.

From this drawing it appears that the ordinary way of working the thin coal seams is in parallel passages, called *boards*, about four yards wide and eight yards asunder; which eight yards comprise a solid mass of coal, supposed to be necessary for the support of the roof, although, in fact, much less would answer this purpose. These *boards* are connected at the distance of every twenty yards by smaller passages, called *headways*, running at right angles: the pillars which support the roof are thus about twenty yards by eight in dimension.

The headways are driven in straight lines through the whole extent of the mine, and are made for the purpose of communication between the boards, in which nearly all the coal intended for sale is raised.

Into each mine two or more *shafts*, or pits, (or one pit *bratticed*, or boarded off, so as to serve the purposes of two) are sunk, by which the coal and water accumulating in the workings are raised. One of these shafts, A, in reference to its use, is called the *downcast shaft*, and the other, B, the *upcast shaft*, by means of which, in addition to its other uses, the gas is carried off. The distance between the two is in general from half to two-thirds, or nearly the whole length of the working. The double lines show the air-stoppings or doors, erected for the purpose of preventing the air from passing into any working, when not necessary.

The

The single lines show the brattices, and the darts and dotted lines, the course of the current of air passing from the downcast shaft through the mine to the upcast shaft, where it ascends.

The system of ventilating Collieries hitherto employed, consists in forming all the boards and headways, or, in other words, passages of a mine, into one immense labyrinth, connected at one end with the downcast, and at the other end with the upcast shaft: this arrangement is effected by fixing up *stoppings*, consisting of brick, or stone and mortar, or strong boards called *brattices*, in such situations as to intercept the current of air in every direction, but that in which it is necessary it should traverse, in order to sweep, as it were, in its course every avenue and corner of the mine. The current of air which enters the downcast shaft, has thus to travel 27 miles in an area of 600 yards square; a distance which it will readily be supposed requires a considerable power to force an effective current through its whole extent: in fact, it seldom happens that the velocity of this current exceeds two miles per hour.

In the first report of a society established at Sunderland for preventing accidents in coal mines, printed in 1814, the following passage occurs, at page 5: "The only method we "are at present acquainted with for preventing accidents by "fire, is a mechanical application of the atmospheric air to "the removing or sweeping away of the inflammable gas, as "it is generated in the workings of Collieries, or as it issues "from the several fissures which the workings intersect in "their progress."

This mechanical application of atmospheric air is produced, according to the above report, in several ways; but all of them have been found either inefficient or dangerous.

Amongst

Amongst these ineffectual contrivances may be reckoned, 1st, The blowing engines for propelling air down the shafts, for the greater part of their power is expended in sending a stream of air through this enormous extent of passage, which stream of air neither operates perfectly in the higher lodgments of the mine, nor in the breaks where gas accumulates.—2d, Falls of water carrying with them a current of air; these render one of the shafts useless for every other purpose, and increase the labour and expences of clearing the mine of water.—3d, The air-pump, which, besides being inefficient to propel a full stream of air from shaft to shaft, deprives the miners of the upcast shafts, while it is at work.

Among the dangerous expedients now in use, it is only necessary to mention the *furnace*, placed near the bottom of the upcast pit, which is supposed to produce the requisite current by the rarefaction of the air within it. Over this furnace all the air of the mine (including of course all the hydrogen gas, mixed in various proportions with atmospheric air,) is compelled to pass.

It is suggested in the report before mentioned, that the furnace should be extinguished the instant an overpowering discharge of inflammable gas takes place in any part of the mine; but the inflammable air may reach the furnace before any previous intelligence of its approach can be given at the bottom of the shafts in time to enable the workmen to extinguish a *chaldron or upwards of burning coals!*

To elucidate still further the present mode of ventilation, (for I consider it essential to bring the two systems in comparison) it may be necessary to state that every coal mine or working is confined to the depth of one stratum, or, in cases where the strata are thin, of two or more, so as not to exceed eight feet in general depth from the roof to the floor of

the mine. The roof, and the floor (or *thrill*, as it is called,) although they are nearly equidistant, are never perfectly horizontal, but incline or *dip* from that position in different angles. From this last circumstance, it is evident that one board will perform a *descending* course, whilst the next *ascends*; thus alternately changing its direction at every turn, and generally leaving a gradually accumulating portion of hydrogen gas at the commencement of every descent, probably mixed with or diluted by atmospheric air, but thus rendered more and more susceptible of explosion on the approach of flame. In Felling Colliery, for instance, the hydrogen gas is supposed to descend in its serpentine course not less than two hundred and fifty feet, perpendicular height, in *each* revolution of the air through the boards and headways. Now, when we recollect that hydrogen gas is so much lighter than common air as to float upon the latter as oil does upon water, it is evident that the hydrogen gas will accumulate in the higher part of every turn or winding of its course, precisely in the same way as the air which lodges in the upper part of a bent water-pipe contracts the passage for the water, and finally stops the current unless propelled with great force.

A similar phenomenon takes place in the coal mines. The hydrogen gas lodges in the upper chambers or crevices until the current of air increasing, and requiring more room, forces the gas into motion, and thus in a state of dangerous mixture or dilution, the two fluids traverse the rest of the workings, seeking the flame which is to arm them with destruction: and here it must be remembered, that the miners *low*, or candle, is equally enabled to communicate explosion as the greatest flame possible: it is believed that all the explosions

plosions at Felling Colliery took place in this way at the upper levels of the mine.

This method of ventilation has frequently been successful when performed in all its detail with accuracy and skill, and under the favourable circumstance of being used in thin coal seams, containing but little hydrogen.

Some of the Staffordshire Colliers were able in this way to clear their six or eight feet seams with a comparatively small loss of life: at last they diluted the inflammable gas to such an extent with atmospheric air, as to produce an unexplosive, and of course a harmless mixture in general; so that this system may not improperly be called the *Diluting System of Ventilation.*

It now remains to describe the method of clearing mines of foul air, by means of what is called the *firing line*, or which, for the sake of distinction, I shall denominate the *firing process.*

This dangerous operation is performed by an apparatus consisting of a long pole, or a series of poles, fitting one into the other, like a fishing-rod, so as to be elevated to the break, or *pot hole*, where fire-damp is accumulated: at the upper end of this pole, a copper wire is passed through upon a small sheave or wheel, which wire is made to reach to any distance within the area of the mine from the horse stable: this done, the pole is firmly fixed in the place where the gas lodges; the candle fixed to a piece of lead, or other substance to keep it steady, is carried by the firemen as far towards the explosive region as safety will admit of, when it is set upon the floor, and fastened to one extremity of the copper wire; this done, the firemen retire to the stable, which is made strong, and well secured, in order to barricade them; the other extremity of the wire is passed through a crevice

in the door, by which means they draw the wire until the light gets to its destination:—in some instances they remain pent up for a length of time, in the greatest suspense, owing to some accidental circumstance having put the candle out, before it reaches the *pot hole*; when they are fearful of venturing out, from the uncertainty of what may be the event.

In many instances it has been found necessary to explode these lodgments three times a-day, at each time clearing the mines of all the workmen except the firemen; the necessity of which has been occasioned by the miners cutting down strata or measures of coal, so as to render their roof higher than the general run of six or eight feet seams, and by these means making the extra elevation too great to be effected by the diluting current. In short, when the roof of a coal mine, where the seam is thirty-six feet thick, is cut down, no means but the *firing process* could hitherto suspend, even for a day, the destructive effects produced by an explosion affecting the whole mine.

The expence of this process, besides the loss of many of the firemen, was immense;—It was necessary to leave an unusual substance of coal in the pillars to support the roof against the shocks; the body of coal itself was besides damaged both by the concussion, and by the heat attendant upon the combustion of the gas; a heat which frequently set fire to the seam of coal, and required the stoppage of the shafts for its extinction.

Lord Dudley and Ward, greatly to his honour, employed the most eminent coal viewers from Durham and Northumberland, to devise some expedient by which the calamity might be averted, but in vain;—with all their skill and ability, not a single explosion was prevented.

It

It is in such mines as these, that my system of ventilation has been brought into use to the fullest extent, and with the happiest results.

Having thus described the methods of ventilation now in use, I shall proceed to lay before the Society an outline of the plan which I have successfully pursued for several years, as testified by the certificates herewith transmitted, and to which I request the particular attention of the Society.

The annexed drawing, No. 2, exhibits the ground plan of a coal mine ventilated according to my system, and worked so as to yield a much greater quantity of coal from any given area, at an expence in no case equal to one-third of the former method.

The *white line* round the square exhibits the gas headway, enclosing a given area, and communicating with the upcast shaft at B.

A, the downcast—B, the upcast shaft.

C represents a collateral gas headway, made to carry off the gas, when a dyke, having thrown down the strata in any part of a seam, renders the elevated or upcast side higher than the general level of the main gas course, in which case this is carried to it, as represented at h, h, in drawing No. 3.

The black squares represent the pillars left to support the roof: by comparing those left in the line from shaft to shaft, within the sectional drawing No. 3, the pillars *d* and *e* will how the stronger supports left under any building.

F, a fall of stone or shale from the roof, which merely knocks down a few pillars, without obstructing the ventilasion.

G, part of a coal seam unwrought, with a working round it, interrupted by a fall of the roof at N, which merely stops up one holing or aperture into the gas headway, whilst the

foul air passes through the next apertures, as represented by the darts *h*, *h*.

The cross darts i, i, i, i, show the holings at the lower part of the mine, made into the bottom of the gas headway; and through which the carbonic acid gas escapes upon the water level.

K, a tube, made to carry off the gas from the upper levels of a mine when not supplied with *holings* into the gas course, in the line of its rise as at e, e, e, this mode admits horses to draw under it, which by the system heretofore used is performed by brattices or partitions, as at M: but it is seldom necessary in my plan to make use of this tube.

The darts show the manner in which the gas creeps off into the gas headway.

Drawing No. 3, exhibits the section of a coal work, with a dyke or *fault* by which the strata are thrown down; and representing the machinery, shafts, &c. used in working coal.

A, the downcast—B, the upcast shaft, having a roof to cover the machinery, and mouth of the shaft, to shelter the *banksmen*, and prevent torrents of rain, &c. &c. from turning the course of the air.

C C, steam engines; d, a rod for conducting lightning, to prevent its firing the gas issuing from the upcast shaft.

E, a dyke, by which the strata are thrown down.

F, the main gas headway, with a rarefying furnace of steam G; h, h, a collateral gas headway to draw off gas from the coal thrown up by a dyke (see C, in ground plan, No. 2.)

K, represents a seam of coals partly wrought out, with the shafts stopped up at l, l, l, l; in order to force the current of air down to the lower seam, and prevent it or the gas from entering the waste.

In

In working the gas headway through the higher parts of a mine, the under strata are bored every twenty or thirty yards a few feet through, in order to draw off the gas from the lower strata. When an open or porous incumbent stratum lies near, the gas may sometimes be let off by boring into it.

If the old system of ventilation is to be abandoned, the pillars left to support the roof may be re-worked to a considerable extent: in my system, pillars will be left without any regard to, or necessity for regularity, so as to afford sufficient support to the roof, and to every locality which may occur to make precaution necessary; by which means much more coal will be obtained from a given area.

Although it may be only necessary to cut a very few yards from the pit or shaft to get on the highest line in the coal field, to effect the mere purpose of ventilation from hydrogen gas, yet it is important to have a thorough knowledge of the stratification to enable me to carry on my future operations with advantage. In the working of coal, an excavation, or gas course, should be driven sometimes entirely round the works for the inflammable and vitiated air, which, being lighter than common air, will go off by the higher level. The carbonic acid gas will from its gravity seek the water level, or the lowest parts of a mine, as shown at i, i, i, i, in Drawing, No. 2.

The dimensions of the holings or apertures into the above gas course, must be judged of from the quantity and relative specific gravity of the gasses which they are intended to receive.

The surrounding of coal fields by headways is generally practised by every intelligent director, as the risk run without such a precaution is very great, and many lives have

been lost, and works shut up from an ignorance of the stratification, a knowledge of which would have been acquired by driving the headway. This course also secures the miners against all sudden irruptions into old wastes, which might, and frequently do, let in water, accumulations of gas, &c. upon the men. In cutting it, the different dislocations met with should be noted down, with their angles, bearings, &c. and transferred to the map, made to govern the general arrangement of the works as the colliers advance. A director who has his field once surrounded, is enabled to examine every part geologically, and can proceed without fear of danger from any quarter: and, as he requires a greater extension of his field, he has only to drive a line off from this common gas passage to still higher parts, should they occur.

The gas-course should be attached to the drawing, or upcast shaft, by two folding doors, one of which should be made to close before the other opens; by such an arrangement, coal can be safely drawn up at the upcast shaft, as the trap or folding doors will prevent the common air from communicating with it: the gas-head should be made to discharge itself a few feet, say ten or twelve, up the shaft, so as to prevent the possibility of flame approaching the gas on its entering the bottom of the pit; with this precaution, lights may be kept in some lower point, on the opposite side of the shaft to that which the gas enters.

The holings, or small gas courses, made into the main gas head-way, must necessarily accompany the works as they advance; or, in fact, it is better to have them made as far forward as possible: the *holings* into the gas-course from the board, or headway adjoining it, may be made with a boring-rod of three inches in diameter, or, if necessary, of a greater diameter; which will be sufficient to carry off the hydrogen gas

gas generated in their neighbourhood: but the principal passage for the gas must be at the very highest part of the workings, into which hydrogen gas, azotic gas, and finally cold air, will flow in succession; but the backs and slips should be mostly depended on to effect ventilation.

It is supposed that by the old system a standard current of air moves through an aperture of thirty feet area, at the rate of three feet per second, which equals 5400 cubic feet per minute; and that this is capable of diluting about twenty-eight and a half feet of gas per second, or one thousand seven hundred and ten feet per minute, so as to render it perfectly harmless; this however only gives three parts of air to one of gass, which, supposing the equality of this proportion, must render it an explosive mixture. But this dilution *is not* regular, nor does the gas distribute itself equally; for in some parts the hydrogen remains nearly pure, and in others diluted beyond the explosive point; but in the higher parts of a mine, a great collection may always be expected, mixed up to various points of explosion, and more particularly at the last of the air, as the accumulations of every other part of the mine must pass through it.

By a gas-head of the same capacity, in my system, I can, according to the above rate of three feet per second, bring off ninety feet of gas in that time; but if the gas be pure, its travel or rate of going will be in proportion to its levity, and the rarefaction in the gas headway. I reckon, therefore, upon the rate of at least ten feet per second, which would carry off 300 feet of gas each second, or eighteen thousand feet per minute: but this generation is far more than can be presumed upon in any mine, so that the extremity of security, afforded by my system, would probably never be put to the test: the distance of its course in a coal-field of nine hundred

hundred yards, will seldom exceed twelve hundred yards. A part of the old works being left with good stopping, will answer the purpose with little alteration of gas headways in my system. But if the gas-course is to be cut in the solid coal, an excavation may accompany it, as described round the upper part of the ground plan, Drawing No. 2, as a board to get coal from; this will take off the gas as it is extricated, and will prove a common passage for the air, which has full liberty to flow through the mine, but on its departure up the shaft will be preceded by the lighter fluids, into the gas-course.

To elucidate my system still further, I will introduce the following analogy: If a large thin book be placed in a slanting position on a bed of clay or stone, and covered with another bed or stratum, equally impervious to gas, it may represent a seam of coal, which is separated into laminæ, correspondent to the leaves of paper. This is precisely the case in these mines, where the seam of coal runs out to the surface uninterrupted by faults: in such mines explosions are never known.

But when the seam is separated by a fault (as shown in Drawings No. 3 and 4,) which, to pursue our illustration, may be imitated by cutting the book in two, with its supporting and superincumbent strata of clay, raising or depressing one portion until the leaves of the book no longer touching each other rest against the clay, and *vice versa;* such a fault it is evident will no longer permit the free transmission of the noxious gas into the atmosphere, from the portion of leaves situate below the fault, whilst that part which still presents its higher edge to the surface, continues as safe as before: in this case, I bore a sufficient quantity of holes from the seam below the fault, or downcast, to the seam above

above it, or upcast, in order to let the gas pursue its course as represented by the section, Drawing No. 4. letter A.

The Netherton and Buffery Collieries in Staffordshire have for many years required the terrific explosions of the fire-line before mentioned, to enable the miners to work them at all, whilst the next coal field, separated from them merely by a fault a few yards thick, but which has thrown its strata fifty yards higher, is entirely free from accumulations of gas.

When these interruptions to the free escape of the hydrogen gas into the open air take place, it naturally forces itself into the workings, through the largest fissures it can find, issuing out in a continual and powerful stream, which the workmen denominate a feeder or blower. By the diluting system, the gas which *thus* issues from the coal is made to traverse all the workings between the blower and the upcast shaft, remaining, it is true, on account of its levity, in the upper part of the courses; but thus insuring its ignition, through the whole extent, if unhappily it comes in contact with flame *.

But when, as by my method, the draught, instead of sweeping through the whole mine, is directed towards those places only in which (from their being situated above the natural current) the hydrogen gas can lodge, it is evident that the fluid, instead of being diffused through the works, is confined to the course which I prescribe to it, and therefore takes the shortest and most ready means of escape.

* Should it escape the miners' lights, the only remedy according to the old system is to extinguish the furnace at the bottom of the upcast shaft. Admitting that it were possible to get the fire extinguished in time: would not this be weakening the ventilating current, precisely at the moment when it is most necessary to increase its velocity?

In

In a mine where the circulating current is thus, in a great measure, kept from admixture with hydrogen gas, I have never found any danger to arise from setting fire to the blower at the point where the gas issues into the works; and by inserting an iron pipe, I have often directed it so as to give light to the workmen.

But when I had driven or bored the top-heads or holings leading into the gas-course from the roof of the mine, and bored the superincumbent strata, as in Drawing No. 4, so as to connect the laminæ with the gas-courses, *the light from the blowers always died away*, and they ceased to discharge gas.

In the old system, this circumstance is frequently produced by the falling-in of the roof, and the formation of what is termed a pot-hole, (an accident so frequent, that it requires the employment of several men in every mine, merely to watch and give notice of it), or from the works intersecting a fissure in the coal; and produces such an increase in the quantity of gas, that the atmospheric air is insufficient for its dilution, and by thus rendering it necessary to augment the power of rarefaction, collects a quantity of burning fuel at the furnace, that cannot be speedily extinguished.

Pursuing the comparison before made of a lodgment of air in a bent water-pipe; what would be thought of the engineer who should endeavour by force to drive it before the water, encountering in its progress perhaps twenty such bends, in preference to the application of a simple tube into the bend where the air lodged? yet such is the process of ventilation hitherto adopted.

But this is not the only evil resulting from the present system:—when approaching old and abandoned workings, in

in which the inflammable gas has been accumulated for several years, if through the neglect of the director, the workmen proceed without the precaution of boring, as soon as a pick-axe penetrates into the open space of the old coal mine, the gas rushes out and ignites by their candles, and if the mine in which they are at work should be in a state of explosive dilution, the dreadful effects may easily be anticipated.

In my system, if by any chance such an accident take place, the consequences are trivial; the eruptive gas, instead of being confined to take its course through a labyrinth of foul air, spreads at once by its levity and elasticity, under a roof of several thousand yards extent, and this the more certainly and rapidly in proportion to the previous purity of the air contained in the mine: here it may burn without danger, and almost without inconvenience to the miner, who pursues his labour below this thin sheet of flame: in a short time it would find the higher levels, and ultimately steal off through the holings into the gas headway, while the men in that direction would naturally descend to a lower part of the workings until it had gone off; even the workmen in the gas course, although they might some of them be scorched, would not perish, as the accelerated velocity created by inflammation would confine the flame to the roof of the gas headway; a fact which has been proved by two instances in Buffery Colliery, at one of which I was present.

Having thus laid before the Society my new method of ventilation in all its details, as succinctly as the importance of the subject will admit, I now beg leave to state what has been

been done towards bringing my system into practice; and this part of my narrative is happily confirmed by numerous certificates, which I herewith transmit to the Society, and to which I beg leave to refer.

The year 1806 was marked by several disastrous explosions in various coal mines throughout England and Wales: in the course of that year, thirty-six men perished by two explosions at Mostyn Colliery, in Flintshire; sixteen by an explosion at St. Helens, in Lancashire; and eleven by another in a Colliery at Whitehaven! These events induced me to think that I could bring the system which I had so long meditated into action. I visited all these Collieries in vain. I also visited Durham and Northumberland, but found here the same prejudices and opposition which I met with in other quarters, and returned without being able to get a trial in any pit whatever. Hurt at the treatment I received, I came to London in 1807, and waited upon Sir John Sinclair, who approved highly of my plans, and immediately introduced me to the Honourable Washington Shirley, whose labours in the cause of humanity and mankind have impressed upon my mind an unceasing sentiment of gratitude; and here I am bound to say, that if my system has any merits, it is to his firm and persevering support it owes its being brought into action, and the perfection it has now attained.

By Mr. Shirley I was requested to proceed into Staffordshire, and was furnished with letters to Messrs. Fereday and Smith, the intelligent mine-masters of that county. Mr. Shirley had in his letters requested the most fiery ground to be appointed for me to work upon.

This being done, the shafts were sunk, and the works driven onward from the bottom, until the inflammable gas began

began to give alarm, but which ceased the instant I put my system into action: this dawning success produced much jealousy amongst the resident directors; but the firm and generous support of Mr. Shirley and the Rev. Mr. Cartwright, (both Magistrates), and of Messrs. Fereday and Smith, who personally accompanied me in all my trials, secured me from any material molestation.

At this time all the pits around me were exploded every morning by the firing process; and, on the 3d of December, 1808, I took charge of the pit next to my new one.

In this mine, I found that "air heads" had been driven through which the air was forced from the blowing or downcast shaft to the upcast shaft; notwithstanding this, however, two explosions were daily required previous to my taking charge; and this had continued for eight years.

Having formed my gas-course from the old works, and carried it to the higher part of the mine, the gas poured out so fast on the men cutting the drift, as to make it necessary to work without candles. I used Canton's phosphorus for light. The explosions, which in this stage of the work were still requisite, sensibly diminished in force, until the gas, escaping by my simple gas-course, rendered them no longer necessary. By way of experiment, I put up a door in the gas headway, with a perforation in the centre, which I gradually enlarged until it was capable of liberating all the gas collected in the workings; and found that the hydrogen, which was competent to produce the tremendous effects before mentioned, was freely permitted to escape through an aperture of only two inches square!

The only alteration I made in ventilating this pit was, to change the mouth of the air-head from the blowing to the upcast

upcast shaft, thus converting the air-head to a gas-head, and enabling the gas to escape by the shortest way.

Previously to the above period, Mr. Fereday had purchased the Buffery Colliery, where a large sum of money had been lost by the effects of its explosions; this Colliery I took charge of, notwithstanding its daily explosions had swept off numbers of men; and, in three months, I rendered it sufficiently safe for the Colliers to disuse the fire-line. These facts are certified by the Letter from Mr. Fereday to Mr. Burn, and by Certificate No. 1.

In consequence of these proceedings, and the numerous distressing accidents which occurred in the northern English mines, a letter was sent from the Society for preventing accidents, &c. to Samuel Fereday, Esq. for the purpose of ascertaining how far my plan had been introduced, and what had been the results; to which the following answer was returned:—

Mr. Wm. Burn.

Bradley Iron Works, Nov. 1, 1814.

Sir,

On my return from a journey, I find your favour of the 15th ult., and, in reply, I beg leave to state, for your information, that I am fully satisfied with the happy results which have taken place in this part of the country by the adoption of Mr. James Ryan's method of ventilating mines, and have no hesitation to say, that many hundred miners are now at work in several Collieries in which I am concerned, that, but for this blessing, would in all human probability have long ago fallen victims to the explosions of hydrogen gas, and which, before his plan was adopted, were so frequent. It gives me great pleasure to hear of the establishment,

ment of an institution which has for its object the amelioration of the condition of so valuable a class of our fellow-men; and shall be happy, if it lies in my power, to promote its views. If any information I can afford you will have that tendency, I beg you will not hesitate to apply to, Sir,

Your most obedient Servant,

SAMUEL FEREDAY.

To MR. WM. BURN.

Southwick, near Sunderland, Durham.

In the mean time I received communications relative to these inquiries, and wrote to the above Society respecting my system, in July, 1815. I received the following letter:—

Southwick, 14th July, 1815.

SIR,

YOUR letter of the 12th ult. and former one have been duly received by me, and laid before the Committee appointed by the Society for preventing accidents in coal-mines. The Committee have since made the necessary inquiry of Mr. Fereday, whose report seems satisfactory; but they have had no answer from Lord Dudley and Ward; they have also otherwise endeavoured to satisfy themselves of the efficacy of your method. The result is, that they are strongly inclined to think that it may turn out to be found a highly important one, and they wish, on that account, to make it at present an object of their particular attention. It may be proper, however, to state to you, that this Society and Committee consist of few persons immediately interested in coal-mines. They have been prompted by humanity alone to endeavour to prevent the fatal accidents that are happening in the Collieries: their funds are at present hardly adequate to any other purpose than that of inquiry and information.

I have therefore to request you to say how far any satisfactory experiment can be made, at an expense within their compass, in a coal-mine here, so as to bring conviction to the coal-owners, that your method, if generally adopted by them, would give the security wanted. The Committee would therefore be obliged, if you could propose some plan of experiment to be made in this neighbourhood, or would yourself undertake such an experiment as would convince them of the entire security of your method, and would be likely to answer the purpose of satisfying the coal-owners here. If the Committee should find it to correspond in point of effect with what they wish, you can have no doubt but that they would endeavour, by all the means in their power, to procure the compensation that such an excellent discovery would well deserve. Be so good as to drop me a line in a post or two.

I am, Sir,

Your obedient Servant,

WM. BURN.

To Mr. JAMES RYAN.

In consequence of this letter, and the inducements therein held out, I left Ireland, where I then was, in August, and proceeded to make such experiments as might answer the views of the Society; after several conferences with the Committee, and particularly with the Rev. Dr. Gray, Dr. Pemberton, and Dr. Clanny, I went over to Newcastle, in order to procure a trial of my system; but did not find any inclination on the part of the agents, &c. to assist me. After I had been there a short time, I wrote to Dr. Gray, as an active member of the above institution, wishing him to exert his influence, and received the following answer:—

SIR,

SIR,

AGREEABLY to your request, I have written again to Mr. Buddle, having before addressed him on the subject of your experiment.

I hope that you will be allowed to make it where you wish, and under favourable circsumtances. With every good wish for your success, and hoping to hear from you soon, I subscribe myself in great haste,

Your obedient humble Servant,

Sunday Evening. ROBERT GRAY.

This letter enclosed one to Mr. Buddle.

Notwithstanding this, however, I found nothing but apathy prevailing relative to any improvement in a system which had by its destruction proved itself so ineffectual; and the circumstances I before detailed will not make it appear extraordinary that considerable impediments were thrown in my way. Before the outline of my system was known, objections began to be started, and in a short time a deputation was sent into Staffordshire to make inquiries about my system; but, unfortunately for me, they preferred the opinions of men whose situations rendered them averse to my plans, to those of the honourable and independent characters I have before mentioned.

On their return, armed as they were with the almost absolute sway over the Durham and Northumberland mines, and additionally supplied with the partial opinions they had collected on their excursion, I found it in vain to argue the merits of my system, as the opposition was too powerful for my individual exertions. I therefore, after much trouble and expence, left Newcastle on the 24th of December, 1815,

and determined to seek justice from a Society where liberality and science prevail.

Before I conclude, I wish to make one further observation on my system. It has been objected, that my gas-courses are equally liable to falls of the roof as what the mine is; this however is erroneous; for, not being intended, like the mine-boards or passages, for the supply of coals, but merely to give passage to the noxious gas, they are comparatively small, and carefully strengthened throughout; in them nothing is left to chance, and this security is effected at very little expence, as their extent is very small compared with the courses in the old method, and, being able to work some part of them in the dark, there is no danger of explosion; but, aided by Canton's phosphorus, or if this should not yield sufficient light, by any safety lamp, I should feel myself perfectly secure in making the preparatory passages through a seam of coals; or, under any other circumstance, where an explosive mixture might for a time prevail.

I beg once more to express my gratitude to the Honourable Washington Shirley, for his indefatigable exertions throughout this cause, and in which he was most zealously seconded by that sincere friend to humanity, the late Rev. Mr. Cartwright, a most upright and intelligent brother magistrate; and to Dr. Thomson, Wm. Allen, Esq. F. R. S., Alexander Tilloch, Esq., the Rev. Mr. Turner, of Newcastle, and Anthony Clapham, Esq., of the same place: to whom I am likewise under great obligations for their assistance.

I have the honour to be, Sir,
Your very obedient Servant,
JAMES RYAN.

CERTIFICATE,

CERTIFICATE, No. 1.

As inserted in the Birmingham Gazette, January 1, 1810.

WE, the Charter Masters of the Buffery Colliery, near Dudley, in the county of Worcester, having suffered material disadvantages from the destructive effects of the vast quantities of inflammable air with which the works were charged, and being conscious of the serious losses sustained by the late proprietors on account of the numerous victims to its ravages, and the impossibility of working the mine while so dreadful a body existed in it, think it incumbent on us to declare, that Mr. J. Ryan, who was engaged in July last by Mr. Fereday, the present proprietor, to ventilate the pits, No. 2, 3, 4, has successfully superseded even the necessity of firing-lines, &c., which before were unavoidably in daily use, to the great terror of the men.

The sensations produced in the minds of the men by so desirable an alteration will be productive of the most beneficial consequences to the mining business, as it is now prosecuted with pleasure and success; and we at once acknowledge our obligations to Lord Viscount Dudley and Ward, the Honourable Washington Shirley, the Rev. Joseph Cartwright, and Samuel Fereday, Esq. for patronizing so invaluable a discovery, and congratulate our fellow-labourers on the prospect of security from such terrible destruction.

WILLIAM TURNER, his mark ⋈,
Charter Master at No. 2.
JOSEPH HATELY, his mark ⋈,
JOSEPH MANSEL, his mark ⋈,
Charter Masters at No. 3.
SAMUEL SOUTHAL, his mark ⋈,
THOMAS SOUTHAL,
Charter Masters, at No. 4.

(Witness) JOSEPH FEREDAY,
Buffery Colliery, Dec. 1, 1809.

CERTIFICATE, No. 2.

THE numerous lives lost in Lord Viscount Dudley and Ward's Collieries by inflammable gas, and the excuses made use of to account for it, left no doubt in our minds as to the fallacy of the system acted upon. Mr. Ryan being employed in 1808 to ventilate the dangerous works, he succeeded beyond our most sanguine expectations, without recourse to the former expedients, which were both expensive and dangerous; being employed to open new works, he never suffered them to accumulate gas; which made the agents say, that it arose from natural causes. To convince them, Mr. Shirley allowed him (Mr. Ryan) to withdraw his system: in two days the agents reported the works to be so infested with gas, that it would be impossible for Mr. R. or any one else to free it, without recourse to the former expensive system, which would take some months to execute. Mr. Ryan then engaged to clear the works in *six hours*, and risk his life in the performance of it; which was executed on the 12th of June, to the entire satisfaction of Messrs. Fereday and Smith, who attended to inspect this trial. Mr. Ryan's system is not effected by the weather, and appears well calculated to guard against incendiaries. On the occasion beforementioned, the agents of Lord Dudley and Ward privately stopped up the air-courses, which had it been done on the old system must inevitably have been attended with death. We have no hesitation in saying, that during a course of experiments for two years and a half, in the most dangerous works, without firing-line or any other expensive precaution, he did not lose one life, neither was any one rendered incapable of labour; and the effects

effects of his operations are still visible and evident in the works.

W. SHIRLEY.
SAMUEL FEREDAY.

London, April 26, 1811.

CERTIFICATE, No. 3.

JOSEPH HATELY, Charter Master at the No. 3, Buffery Colliery, will, upon oath, if required, prove that his pit was the only one the gentlemen from Newcastle went into at the Buffery, and they put the following question to him :—

Was you troubled with fire before Mr. Ryan was employed ?—I answered, that we used the firing-lines regularly before, and have not used them since; that the method used by Mr. Ryan was not in practice to my knowledge before Mr. Ryan introduced it; and that we are not in fear or danger of fire at the present time; that my employers, Mr. Jones and Mr. Joseph Fereday, directed me to take them into the pit, and to tell them the truth.

The signature of JOSEPH HATELY,
Witness to the signing, MICHAEL BILL.

Buffery Colliery, 5d February, 1816.

CERTIFICATE, No. 4.

Percy street, Newcastle, Nov. 5. 1815.

SIR,

IN compliance with your request, I have no hesitation in repeating what I stated to the first meeting at the Assembly-rooms; that having in June last had some conversation with Mr. Baddaley, of Dudley, on the accidents which have lately happened in this neighbourhood, and having asked in my turn respecting the accidents in the Dudley coal-mines, I certainly understood him to say, that they had been much

fewer, from the explosion of inflammable air, since a person of the name of Ryan had been in that neighbourhood.

I am, Sir, &c.

WM. TURNER.

To Mr. JAMES RYAN.

CERTIFICATE, No. 5,

From the Tyne Mercury, 12th Sept. 1815.

At a meeting holden on the 9th of September at the Assembly-rooms, in Newcastle-on-Tyne,

Resolved—That Mr. Ryan, having submitted to us his plan of Ventilating Mines, we do highly approve of it as consistent with the principles of philosophy, and that we recommend it to be taken into consideration by persons interested in the coal mines.

R. W. GRAY,	CHRIST. BENSON,
WM. TURNER,	WM. CLARK,
J. H. BIGGE,	WM. ARMSTRONG,
N. JOHN WINCH,	DIXON BROWN,
J. CARR,	ROBT. W. BRANDLING,
JOHN HODGSON,	ANTHONY CLAPHAM.

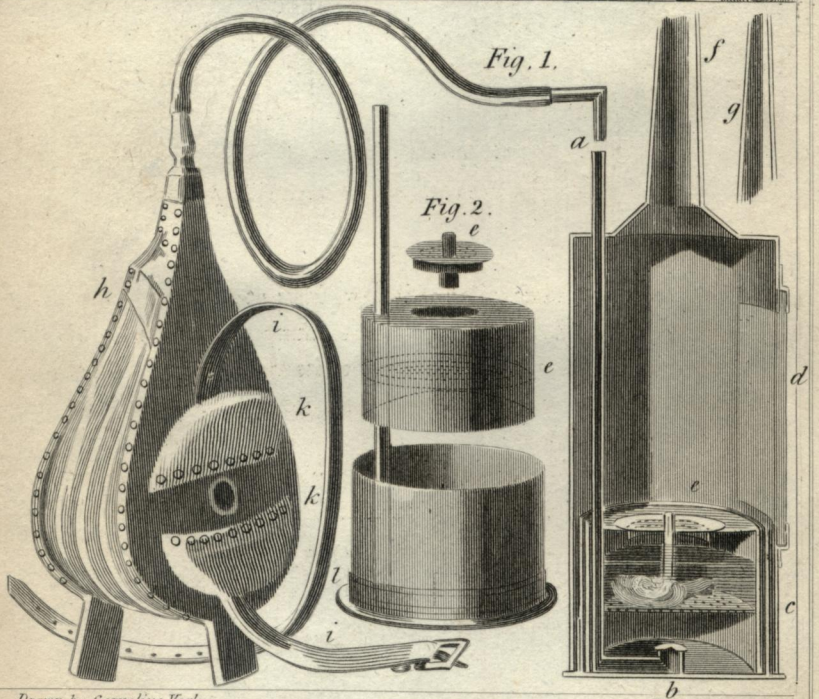
CERTIFICATE, No. 6.

Walker's Hotel, Bridge Street, Blackfriars, May 2, 1816.

DEAR SIR,

I WAS from home this morning when you called, which was rather a disappointment to me; however I answer your letter with great pleasure.

Certainly, I do recollect when you were at Buffery Colliery, and but for your plans, though I cannot say I am fully acquainted with them, but I now repeat from my father's ideas of ventilation, I do believe there would have been a great many



Drawn by Cornelius Varley.

Engravd by A.W.Warren.

Doctor Clannys Safety Lamp.

many more lives lost than there has been of late. And when I recollect the time you, with many others, ventured down one of the pits at Buffery Colliery, which had been for some time stopped up, and cleared it of the inflammable gas, I must own I was quite surprised.

When the explosion took place at Mansell's pit, I recollect it was the opinion of every one present, that all the men then down were certainly lost,—but, to my great astonishment, not one was hurt.

I remain, Dear Sir,
Yours, &c. &c.

DUDLEY FERYDAY.

To Mr. JAMES RYAN, &c.

The SILVER MEDAL *was this Session voted to* DR. CLANNY, *of Bishop-Wearmouth, near Newcastle, for his Safety Lamps. The following Communications on the Subject were sent to the Society, and the Lamps are preserved in its Repository.*

SIR,

DR. CLANNY having forwarded two lamps to me, from Sunderland, which he is desirous of presenting to the Society of Arts and Sciences, for some mark of its approbation, I have to request that you will have the goodness to signify his wishes to the Society.

The Lamps are for preventing explosions in coal mines; one of them being an improvement and modification of his original lamp; and the other upon a new and interesting principle.

When

When before the Society, I shall be happy to attend to give any information in my power, in regard to their application, and to testify the experiments which have been made upon them by Certificates given at the time.

I have the honour to be, Sir,
Your most obedient humble Servant,

J. H. H. HOLMES.

Adam Street, Adelphi, 14th April, 1816.

To C. TAYLOR, M. D. SEC.

The Steam Lamp.

THE principal nicety requisite in the management of this apparatus, is its first preparation for use, as it is necessary to produce a sufficiency of heat within the lamps to establish a current air.

Some boiling water being put into the cistern, within the lamp for about one inch and a half high, the top should be put on, and the oil lamp attached to its place; this done, the cistern and lamp may be affixed within the Chamber, leaving five or six minutes to heat the lamp before the bottom is put on. In the first instance, a condension will take place, and cover the glass with steam; this will, however subside, or, if the bottom is taken off, and the glass carefully wiped, a recurrence of the same thing will not take place.

The Blast Lamp.

IN using this lamp, the bellows are placed under the right arm, like a bagpipe player, and, an elastic air tight tube fixed to their muzzle as an end, and the conducting tube at the

the other, which, when the bellows are urged, conveys the air for supporting the combustion of the candle.

By fixing the bellows to the end of the conducting tube, as now attached, the above means will be ascertained.

The lamp should be nearly filled with oil before the burner and oil aperture are put in:—the condension, which shortly after lighting the wick covers the glass with steam will soon subside, and the glass become clear. Some improvement is proposed to be made in this lamp by having the bottom to fix on in a different manner, and so as to be more air tight.

The lamp is to be suspended by a belt, on the left side.

The following Letter was addressed to Dr. CLANNY, *by* Mr. WILLIAM PATTERSON, *Engineer to the Painshaw Law Colliery.*

SIR,

IN answer to your letter of yesterday, I have the greatest pleasure in stating to you, that your original safety lamp for the prevention of explosions in coal mines, which has been known to the public for many years, and which, in your own hands, accompanied by Mr. Holmes and myself, afforded the first safe light in a coal mine, charged with inflammable air, is now in constant use in all cases where light is required in the Herrington mill pit, and that in no instance has the light ever failed, nor is there the smallest chance for the occurrence of any accident from fire-damp where this valuable lamp is used.

Some time ago I descended the engine pit, which, from foul air, had not been visited for nearly two years, with any sort

sort of light. In this pit the water was in such quantity, that the lamp and myself were on all sides enveloped by it, and no lamp with apertures or wire gauze could have afforded me a light for five minutes; yet here, surrounded by fire-damp and water, the candle continued to burn, and I came to the bank with the light unextinguished. The necessity of supporting combustion in this lamp by a pair of bellows is abundantly compensated by the safety and brilliancy of the light. In both of these respects, I will venture to affirm, without fear of contradiction, that this lamp excels any other hitherto offered to the public; all of which have been constructed upon your plan of insulating the light.

It was, I know, your benevolent intention that each of the poor pitmen's children, who were competent to the task, might earn six or eight pence a day by keeping the bellows going. But as this manual labour has been objected to by some, it affords me additional pleasure to be able to give you a most favourable report of your new lamp, which supplies itself with air, and in which explosion is completely prevented through the medium of steam. Your trials of it in the presence of Mr. Ward, and of my son and myself, on the 30th ult. in an atmosphere of fire-damp of the most powerful nature, as expressed in the annexed Certificate, gave me the greatest confidence in its perfect security; and the following day I carried it into those most dangerous places of the Herrington mill pit, where you first used your original lamp, and in all instances it continued to give a clear light in perfect safety.

When the lamp was carried into an atmosphere of fire-damp at the firing point, the flame increased in magnitude,

and

and sent off flashes of a blue light, but, as they were very slight, the flame at the wick was no way changed, except as stated above. As you formerly remarked to me, so it occurred. The flame was steady, and continued to burn at the wick under every change and modification of the air. This circumstance gives your new lamp a decided superiority over every other.

I will not take up your time by spun-out descriptions of the effect produced, and appearance observed in the determined and decisive trials which I made with your lamp in places of the mine where no persons ever approach with a candle. I am persuaded, that, as your endeavours for the prevention of explosions in coal-mines have been both laborious and expensive, and compleatly effectual, you will receive those rewards you eminently merit, and which are due to you alone. You were the first who turned the attention of the public to the subject of safety lamps, without which a perfect system of ventilation could never be obtained in the coal mines of this district, nor the working of many of them be carried on. Of these safety lamps, you was the first and original constructor, and you was the first to descend into a dangerous mine, and make the necessary trials in an atmosphere of fire-damp at the exploding point. Of all these trials at the shaft and in the mine, I am proud to acknowledge that I had the honour to be your companion.

I have employed your improved original lamp on an atmosphere of fire-damp, in the Herrington mill pit, with complete satisfaction. In it the light was truly brilliant, and though your first, or original lamp, required no machinery or philosophical knowledge to direct its use, and was by no means expensive, yet your recent improvements have rendered

dered it almost a new lamp. The œconomy, the portability, and simplicity of this lamp, require no comment from

Your obedient humble servant,

WILLIAM PATTERSON.

Engineer, Painshaw Law Colliery.

To R. CLANNY, M. D. Bishops Wearmouth.

Experiments made with Dr. CLANNY'S *Lamps.*

THIS day, we the undersigned witnessed the experiments made with Dr. CLANNY'S two new lamps in a field of inflammable air, at the firing point.

In the lamp with oil as a valve, the fire damp was burnt at the wick, and there continued to burn for a considerable length of time, till the quantity of atmospheric air was so diminished by the increase of the inflammable air, that the light was extinguished from that deficiency alone.

In the lamp in which steam forms a perfect valve, the same effects followed when it was used in a field of fire-damp at the exploding point. In both instances the light was permanent, and would have continued so, had the atmospheric air not been ultimately over-balanced by the inflammable air.

In our opinions, these lamps are the only ones hitherto discovered, which can afford a safe light with inflammable air in the midst of a field of inflammable air; and, that the fire-damp or inflammable air will, in all instances, be overcome, and ultimately destroyed by using these lamps alone.

Given under our hands, at the Herrington Mill-Pit, this 30th day of March, 1816.

(Signed) J. R. WARD,
W. PATTERSON,
W. PATTERSON, jun.

Reference

Reference to Dr. CLANNY's *Safety Lamp, Pl.* 7.

Fig. 1, section of the lamp: *a* the pipe into which the flexible tube of the bellows is fitted. The air is forced down this pipe, and rises at *b*, through the oil: *c*, a plate or false bottom, perforated with holes; this supports the cotton, and prevents the portion of oil at bottom, (which is needful to cover the air pipe,) from being consumed: *d*, a curved pane of strong glass: *e*, the plate round the burner, full of holes, by which the air is supplied, near the flame: *f*, the chimney: *g*, a piece to be added at the top of the chimney. This chimney is so much excluded, that when an explosion takes place in the lamp, the flame will not reach the top, so as to communicate with the outside; and the oil cuts off all communication with the feeding pipe: *h*, the bellows: *i*, *i*, straps and buckle to fasten round the boy's waist: *k*, *k*, two cushions to bind the bellows steadily to his side, and leave room for supplying the air-hole.

Fig. 2, the two inner parts of the lamp separated. The lower vessel contains the oil, and is wrapped round at 1, with leather or soft thread, to render it air tight: the part *c*, is open at bottom.

The Drawing shows the lamp slung to the boy's neck, and the bellows strapped to his side; the pipe is placed behind, and passing under his left arm, is inserted into the lamp.